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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/833,372

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Michael Wojtowicz

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08/28/2002

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EXAMINER

BAUMEISTER, BRADLEY W

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 08/28/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/833,372

Applicant(s)

Wojtowicz

Examiner

B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Aug 2, 2002
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 2 6) ☐ Other:

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DETAILED ACTION

Election/Restriction

1. Applicant's election without traverse of invention I in Paper No. 4 is acknowledged.
2. The Application has been transferred to another art unit for examination of the elected product claims. Upon further consideration of the originally-filed claims, the newly-assigned Examiner is of the opinion that the restriction was in error. Regardless of whether the basis for restriction was or was not proper, the claims of the two inventions are so closely related, that examination of both the product and method claims does not appear to constitute an undue burden. Accordingly, the restriction requirement of paper #3 is withdrawn, and all of originally-filed claims 1-11 are under active consideration.
 - a. The Examiner notes that any subsequent amendments to the claims may require that the restriction issue be revisited.

Specification

3. The disclosure is objected to because of the following informalities:
 - a. Paragraph [0005] appears to include some clerical errors that render the disclosure confusing and/or inaccurate. For example, "holes are ejected [sic: injected] into the emitter layer into [sic: from?] the base layer... The injection of holes into the base [sic: emitter?] layer..."

Appropriate correction to these and any other errors in the specification is required.

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Claim Objections

4. Claim 7 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 6 is directed towards a method or process of forming an HBT and includes a limitation of forming a base layer. Dependent claim 7 states, “[the process of claim 6,] “wherein said base layer is formed.” As such, this claim adds no further limitation to claim 6.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1-5 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Independent claims 1, 3 and 5, each possesses a double-inclusion of limitations directed towards the n⁺ AlGa_N emitter (see e.g., claim 1, lines 7-9). It is unclear whether this is a clerical error, or if two n⁺ AlGa_N layers are, in fact, intended to be claimed. The former interpretation is provisionally presumed since the specification does not provide any suggestion to provide two n⁺ AlGa_N layers, but appropriate correction is required to confirm this interpretation and clarify the claims' intended meanings.

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Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1 and 6-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Song '944 in view of Chow '212.

a. Song generally discloses a GaN-based HBT (see FIG 3): on a substrate 5 is formed an n⁺ GaN subcollector 3; an n- GaN collector; a p⁺ GaN base; an n AlGa_N emitter; and contacts formed on the subcollector, base and emitter, respectively. The claims are not anticipated because Song does not disclose an AlGa_N/GaN superlattice employed for the base.

b. Chow '212 teaches that HBTs may be provided with graded or CHIRPed superlattices so that the effective bandgap of the base decreases from the emitter side to the collector side for improving electron drift across the base and that the bands of the base and emitter can be aligned (e.g., FIG 4 and col. 6, lines 23-44). It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed a superlattice, at least such as a CHIRPed superlattice, in the base of the Song HBT for the purpose of improving the carrier drift as taught by Chow. Further, it would have been obvious to have employed a superlattice specifically composed of AlGa_N/GaN because Chow discloses an emitter composed of AlGa_N

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and a collector composed of GaN, so using these specific materials in the superlattice would enable good lattice matching between the emitter, base and collector, and would allow alignment of the base and emitter bands.

9. Claim 5 is rejected--and claims 1 and 6-9 are alternatively rejected--under 35 U.S.C. 103(a) as being unpatentable over Song/Chow as applied to the claims above, and further in view of Razeghi '277 (previously made of record in IDS #2).

a. As explained above, Chow provides motivation for *why* one would have wanted to employ an AlGaN/GaN superlattice in the base region of the Song HBT. Assuming *arguendo* that Song and Chow must be read so narrowly as not sufficiently teaching that one actually *could* form a p+doped superlattice of AlGaN/GaN, Razeghi provides further evidence that it was known at the time of the invention by those skilled in the art how to form a p+ AlGaN/GaN superlattice. Thus, it would have been further obvious to form a base superlattice from the specific materials of AlGaN/GaN because these are the materials specifically employed in the various regions of Song and Razeghi teaches how to form a superlattice using these materials.

b. Regarding claim 5, Song doesn't disclose what particular materials may be used for the substrate on which the GaN-based HBT is grown. Razeghi teaches that sapphire or SiC may be employed as a substrate for GaN-based devices thereover (col. 3). It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed sapphire

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or SiC for the substrate as taught by Razeghi because these are the two primary substrate materials used for GaN-based device due to lattice-matching issues.

10. Claims 2-4, 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Song/Chow or alternatively Song/Chow/Razeghi as applied to the claims above, and further in view of Ohta et al. 206.

a. The claims mentioned in the previous paragraphs set forth a superlattice (i.e., a structure having an irregular band gap energy), but do not further require that the AlGa_N barriers be graded across the superlattice (i.e., do not require the barrier Al content to decrease from the emitter towards the collector). Claims 2-4, 10 and 11 do set forth this limitation; and Chow does not expressly teach this limitation because Chow alternatively uses CHIRPed superlattices to produce effective changes in the base's bandgap (i.e., wherein the barrier and well concentrations remain unchanged, but their successive, respective thicknesses are altered).

b. Ohta teaches that either CHIRPing or barrier-grading can be employed in superlattices to produce effective band-gap changes in superlattice structures (see e.g., FIGs 14-21). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to have employed barrier-grading as taught by Ohta instead of the CHIRPing in the superlattice taught by Song/Chow, or alternatively Song/Chow/Razeghi, because the two grading schemes are functionally equivalent, both conventionally known at the time of the invention and because barrier-grading enables the use of constant thickness (i.e., thinner) barrier and well layers,

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and does not require taking into account the change of each barriers' and wells' respective thicknesses for design calculations.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. The following references provide evidence that it was well known to use various methods to grade an HBT's base to decrease the effective band gap towards the collector.

- i. Christian '970 (FIG 4b)
 - ii. Swanson et al. '065 (e.g., Fig 11 and col. 11, line 26)
 - iii. JP '934
 - iv. JP '164
 - v. JP '361
 - vi. IBM Technical Disclosure Bulletin # NB8908128,
- b. JP 6-61245 teaches compositional grading of a superlattice's well to alter the effective bandgap.
- c. Micovic '945 teaches an HBT with a superlattice base (col. 4, line 51)
- d. Shimura et al. '273 teaches a base-collector superlattice that employs both CHIRPed and compositional grading (e.g., FIG 5)
- e. Ishibashi et al. '204

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INFORMATION ON HOW TO CONTACT THE USPTO

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at **(703) 306-9165**. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

B W Baumeister 8/17/02

B. William Baumeister

Patent Examiner, Art Unit 2815

August 17, 2002